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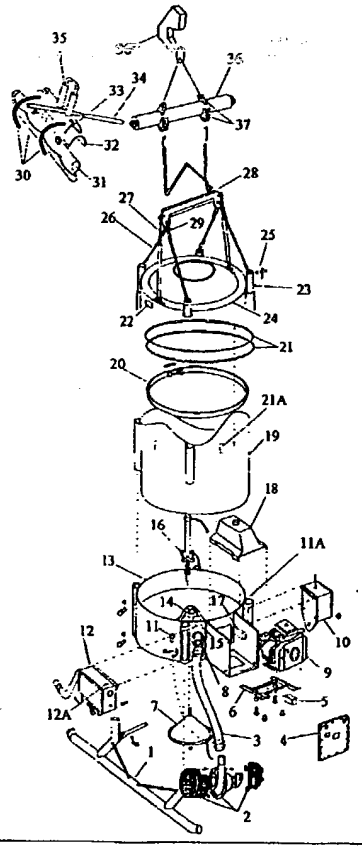
(54) Title: ARRANGEMENT FOR EXTINGUISHING OF FIRE, FIRE FIGHTING BUCKET

(57) Abstract

Arrangement for extinguishing of fire in vegetation, buildings and maritime constructions. The invention is constructed to be transported as a single sling load below a helicopter and to be operated from the helicopter. The invention consists of one each six main units as said tank module (13-16, 19-29), said hydraulic module (12), said electronic/radiomodule (10), said pump module (2, 3, 8), said motor module (5, 9, 18) and said antirotation module (30-37).



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ARRANGEMENT FOR EXTINGUISHING OF FIRE, FIREFIGHTING BUCKET

Arrangement for firefighting in vegetation, buildings and maritime constructions. The invention is basically constructed to be transported as a single sling load below a helicopter which can be operated wireless by the pilot to accomplish the fire extinguishing. The arrangement is denoted as a firebucket.

Firefighting is accomplished traditionally from ground against buildings and vegetation. When fires araises in vegetation and when it is difficult to enter into the firefront area with ground firefighting equipment and personel, improvements have been made by using helicopters. Today two systems are available for use on helicopters, designed by Con-Air/Isolair and Finet France.

All these systems are designed with a water tank mounted to the airframe structure with the hydraulic/electric power output taken from the aircraft main transmission or engine assembly. The system operates electrically from pilot flight controls. To obtain proper space between tank and ground, a higher landing gear has been constructed by Con-Air. The aircraft modification time and equipment installation time for noted installations, is exstreamly high compared with the system A/S Lufttransport has developed.

Disadvantages with the existing fire fighting systems:

- The equipment is dedicated to restricted types of aircraft.
- Long installation time
- Long modification time
- Low flexibility
- Low or none spread effect
- Long grounding time if snags occure on the helicopter.
- Can not be used as a mobile water tank
- Low water capacity (Max 1400 ltr)
- Very expensive
- Excessive spare part production time
- Long refilling time
- Partial restricted for accomplishment of external load misssions.

The aim of subject invention is to establish a firebucket which is moore effective, flexible for operational services, easier to disassemble and easier to maintain than existing firefighting equipment used for helicopters in geographical environments with few, small low leveled water sources.The assembly is not a fixed installation on aircraft and could be used on all type of helicopters in weight classes the equipment is designed for. Backup helicopters independend of aircraft type, could be put into service without any modifications within approximately 5 minutes. Noted firefighting system will not delay any normal helicopter operating missions, as; slingload, logging or passenger transports.

Principles used is to construct a firefighting bucket which can fill 2700 ltr of water within 1.5 minutes using its own energy and keep the aircraft flight characteristics in airspeeds between 40 and 120 kts without applying torque to the aircraft cargo hook system. The helicopter must be total independend of ground personel by using a self pickup system and a radiocontrolled system. All control functions must be operated from a main control panel attached to the helicopter collective stick, like start/stop, refill/stop, water drop and water bomb. The ejection system must be constructed to achieve a high water spread effect which increase the fire extinguish efficiency. The ejection system must be constructed to implement possibilities of dropping water into different areas. A system must be implemented to give the firefighters the possibility to connect their own equipment to the bucket and use the assembly as a water source. The Bucket including the antirotation system must be released from cargo hook in accordance with Federal Aviation Regulation part 27, Norwegion Civil Aviation Regulations (BSL D-5-5) and the Norwegian Labor Administration Authority Regulations. The bucket must be tested to obtain a proper aerodynamic and static stability in airspeeds up to 120 kts and in all flight characteristics, including high turbulent conditions.

Additional details is described as follows and illustrated in enclosed drawings of the invention. Figure 1: Illustrates the invention completely disassemblied. Figure 2: Illustrates the invension completely assemblied

The arrangement is an aluminum construction assemblied with a bottom section, a web, support, tubes and quick release bolts hinged up via an antirotation beam (36) to the helicopter cargo hook (38). Two antirotation tubes (34) is mounted to the antirotation

beam (36) through a loop (35) and clamped with 3.ea clamps (30) around helicopter skids. Subject assembly will prohibit the firebucket to rotate in low airspeeds (below 40 kts) and in hover.The helicopter has two cargo release functions which can be operated by the pilot. One electric system which can be operated from cyclic stick and one mechanical system which can be operated by a pedal mounted in front of the pilot in cabin floor. (Both systems are basic helicopter cargo hook installations and not a part of the invention)

If desired, the pilot can release the antirotation assembly (36) from cargo hook. This will make tube (34) to slide out of loop (35) and release the entire assembly from the helicopter skid (31) Release of cargo hook is beeing performed whenever aircraft is in an emergency situation or if the firebucket not keep the flight characteristic performance. (uncoordinated turns or abnormal wind or weather conditions restricted in accordance with the aircraft basic flight manual) An additional task to the antirotation system, is to give the pilot the oportunity to hook up the bucket on transverse beam (28) without help from ground personel.

The transverse beam (28) is mounted via four wires (26) and four main support tubes (23) to bottom section (13) by use of solid bolts and quick lock pins. The top cone (24) prohibits the main support tubes (23) to collaps during bucket waterloading. Between top cone (24) and bottom section (13), a waterproof web is fastened with an expansion ring (20) in lower bottom section and supported with two support rings (21) which are mounted on web inner side with shoe strings (21A) and with a jacking strap (22) to the top cone. The web is tightened by use of four tightening bolts (25) which pull top cone (24) from bottom section (13)

Tapered waterproof bottom frames is welded inside bottom section (13) for retardant mixture and hydraulic oil.The retardant tank and the hydraulic tank have its own filler necks (11 and 11A). A water ejection hole with packing groove is reworked out of center bottom section (13) A hydraulic drop cylinder support (14) is welded to bottom section cone and attach a hydraulic drop cylinder (16). An ejection cone (7) is connected to the hydraulic drop cylinder (16). The ejection cone (7) is designed as a cone to increase the water spread effect.

A hydraulic driven water pump assembly (2) is mounted in lower end of water filling hose (3) attached in a wire strapped together to three hydraulic hoses. Filling hose (3) is mounted with two 110 mm clamps to input tube (8) (which is welded to bottom section (13)) and to water pump (2) output tube. All hydraulic hoses are connected to the hydraulic system with quick release connectors. The firebucket landing gear consists of two skids (1) which are mounted to bottom section (13) with solid bolts and quick release pins.

A 18 HP piston engine (9), battery (5) are connected to a mounting frame (6) which is slided into bottom section (13) engine compartment and locked with solid bolts and quick release pins. All hydraulic hoses from engine hydraulic pump are connected to the hydraulic system with quick release couplings. The electrical control system is connected to engine assembly with a electrical quick connector.

A hydraulic modul (12) is hinged up on engine compartment right hand frame and secured with a solid bolt and locked with a quick release pin. All hydraulic hoses are connected to the hydraulic system with quick release connectors. The electrical control system is connected to the hydraulic module (12) with a quick release electrical connector.

An electronic/radio module (10) is hinged up on engine compartment left hand frame and locked with a solid bolt secured with a quick release pin. A gasoline fuel tank (18) is a part of engine compartment top cover with the fuel hose connected to engine carburettor with a quick release coupling. A front cover (4) is mounted in front of the engine compartment and locked with two receptacles.

A water drain valve (17), is fitted for the firefighters ambulating equipment and mounted on left hand forward side of bottom section (13). If desired, subject drain valve could be connected to the firefighters fire extinguishing equipment and in respect to this, the firebucket could be used as a mobile water tank.

The firebucket water capacity can easily be regulated by fabrication of a new waterproof web (19) and shorten lenght of main support tubes (23). The invention is constructed to obtain a maximum weight of 3000 kg based upon safety factor requirements stated in the Norwegian Civil Aviation Regulation (BSL D-5-5) will fit all type of aircraft equipped with cargo hooks.

The firebucket might be used as a mobile water tank and in respect to this, the helicopter can supply water continuously to ground personel by picking up empty bucket for refilling while ground firefighters use water from the newly supplied refilled fire bucket. The firebucket can be used on buliding and industrial fires due to the high water spread effect, because the spread water avoid a wooden construc-tion to break down.

The firebucket is constructed to obtain a high aerodynamic velocity without rotating. The shape of the bucket and studies of the bucket center of gravity variations, is a very important aspect to get the areaodynamic stability of the assembly. Wrong position of center of gravity position might give an extreame pendel effect which could result in an emergency release of bucket from aircraft.

If snags occure on the helicopter in operation, a new helicopter without any prior modifications could be easily put into service within a maximum periode of 5 minutes. (Time required to install the radiocontroller to collective stick by use of two screws and six plasticstraps) The Firebucket assemblies can be completely disas-semblied within few hours and shipped with regular air transport. Two firebucket assemblies can be transported in a Bell 205, 212 or 214B-1 cabine.

The pilot controlpanel consists of five monitoring lights and have following function during firebucket normal operation.

a) The green light indicate that the radio is within range and two way commun-ication is established.

b) The red light indicate that the radio is out of range. (Signal level to low, at distance over approximately. 200 meter)

c) The orange light indicate a low hydraulic system pressure witch is insufficent to keep the main ejection cone closed.

d) The second red light indicate "engine at fire bucket out".

Additionally the pilot control panel consists of fours switches with five functions.

i) The engines ignition switch.

ii) The engine start switch.

iii) The water drop switch.

iv) Switch for water refilling..

The radio control system consists of two separate units. One located inside cockpit and the other unit on the fire bucket (10). The subject units comunicate with coded radio signals at 440 Mhz. Both tranceivers (units) is matched on a fixed frequency , this to avoid conflict with other operating systems nearby. Inside the transceiver unit for the fire bucket there is installed a number of relays who is controlled by the receiver. The relays is choosen to obtain isolation between receiver unit / power system and to control large current. The relays control the hydraulic pump, drop/bomb, engine start , ignition and engine power.

The engine may be started by the pilot during flight by switching on the ignition and press the start switch. The engine is monitored with a red "engine out" light , and the light will exstinguish immediately after engine start.

When the engine is running on idle , the hydraulic pressure will rise , and the hydraulic cylinder (16) will move the ejection cone (7) (the main water door) against close position , until the ejection cone is completely closed. The pressure will keep the door closed. In case of main hydraulic pressure drop, a pressure switch will monitore low pressure via electrical system (10) to the electrical selector-solenoid installed inside the hydraulic compartment (12), that the hydraulic pressure to the drop cylinder (16) has to be rised to keep the ejection cone (7) closed.

By operating the fill switch , a relay inside fire bucket radio module (10) activates and the power solenoid at the engine opens the throttle completely. At the same time the electric selector valve directs flow to the hydraulic motor and power the water pump (2) at the end of the filling hose. In case of pressure drop in cylinder (16) , the ejection cone (7) starts to open. This will be monitored by the pressure switch and the electrical selector solenoid change position and starts charging of the system pressure. When the pressure is raiced to normal value below piston in the drop cylinder (16), the electrical solenoid selector change position back to filling mode . It means that a low system pressure has priority prior to filling mode. (It makes no sense to fill a leaking bucket)

By operating the drop switch momentarily, the pressure line is closed and the drop cylinder (16) is by-passed to return line directly to the hydraulic tank. The water gravity will force the ejection cone (7) to fully open and the water will be ejected out by gravity. If the pilot stop pressing the drop switch , the by-pass of drop cylinder stops and pressure is refeeded back below piston inside drop cylinder (16) and the ejection cone (7) is going to closed position. (The ejection cone is gradual adjustable depending on the time the switch is pressed or unpressed). Due to this, the water might be devided in small doses to different geographical areas. By engaging the drop switch continiously, the maximum available water capacity of 2700 litre is measured to be ejected within 3.5 sec.

The firebucket with P/N 555-25-034-01 is disassembled to five modules and each module could individually be changed within a few minutes. (Main tank module, hydraulic module, electrical/radio module , pump module and engine module). Each of the modules are mounted to each other with quick pins and quick locks. All the hydraulic connections is quick connectors and there is no need for tools to change those modules.

The invention is not restricted to affect said exsamples of accomplishment, but might cover close accomplishments build up on the same principles of solution.

CLAIM

Arrangement for extinguishing of fire with tank, pump and foundation, characterized with said tankmodule (13 - 16, 19 -29), said hydraulicmodule (12), said electronic/radiomodule (10), said pumpmodule (2,3,8) said motormodule (5, 9, 18) and said antirotationmodule (30 - 37)

AMENDED CLAIMS

[received by the International Bureau on 28 November 1994 (28.11.94); original claim 1 replaced by new claims 1-4 (1 page)]

1. Arrangement for extinguishing of fire used during helicopter firefighting with a partial closed and collapsible tank, water ejection and refill system, self pickup system and foundation, a bottom section and a top cone means a web is arranged to be holded and streched out with fours support tubes characterized with

- said formed cylindric box with open bottom section (13) with an arrangement of said expansionring to clamp up said web (19) against bottom section (13) innerside,
- a said pump (2) arranged together with said power unit (9,18) for filling of water into tank assembly.
- a said drop cylinder (16) for operation of said ejection cone (7) to empty water out of said tank assembly,

controlled from a controlpanel mounted on pilot flight control stick by a radio tranceiver.

2. Arrangement according to claim 1, characterized with that said tank assembly is connected to the helicopter cargo hook (38) by a self pick up single horizontal beam looking said stabilizing system (36) means each of its ends is movable and arranged against a horizontal axis tube (34) which through said bow (35) on the helicopter skid (31) and where said stabilizer system (36) is arranged with a hook whose function is to collaborate together with said top cone (24) via said transvere beam (28)

3. Arrangement according to claim 1, characterized with that tank assembly control system is controlled wireless by said electro/radio module (10)

4. Arrangement according to claim 1, characterized with that said water ejection cone (7) is formed conical and where said dropcylinder (16) is connected to the top of said ejection cone (7).

FIGURE 1

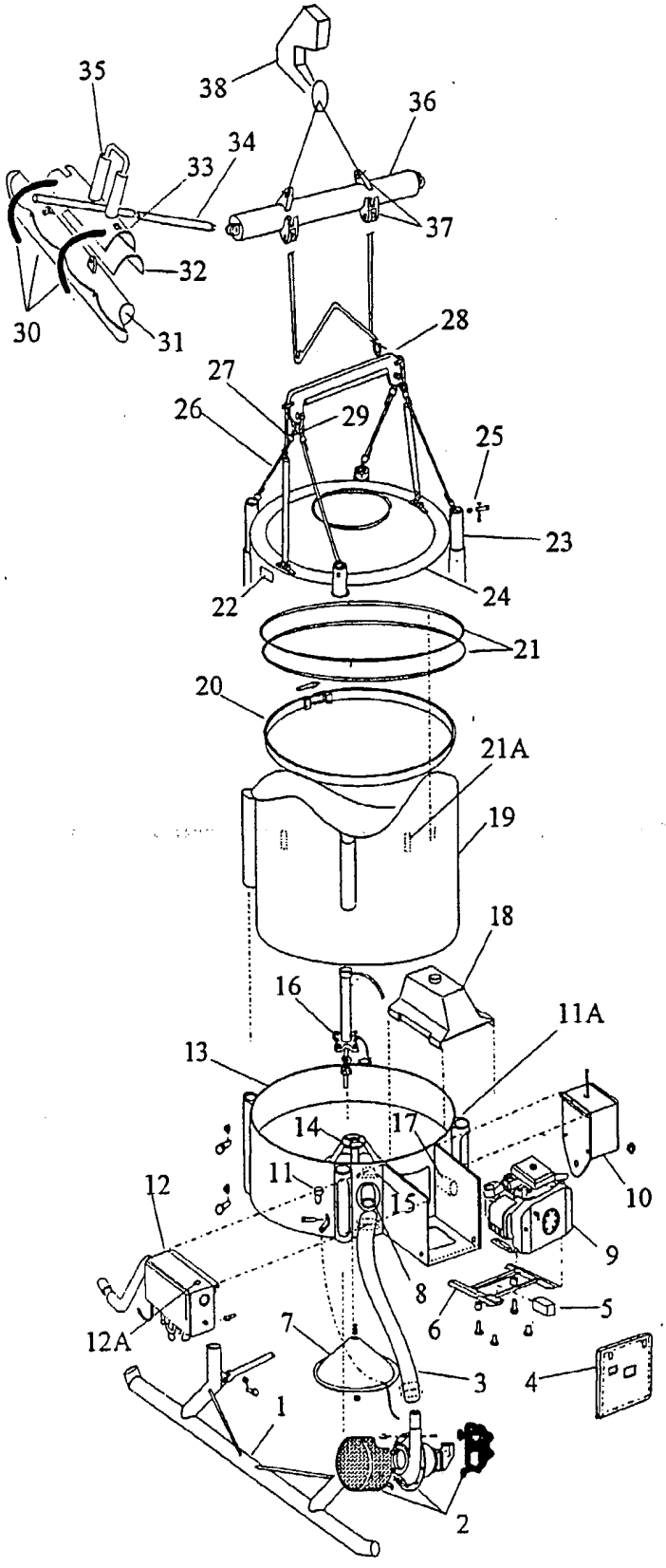
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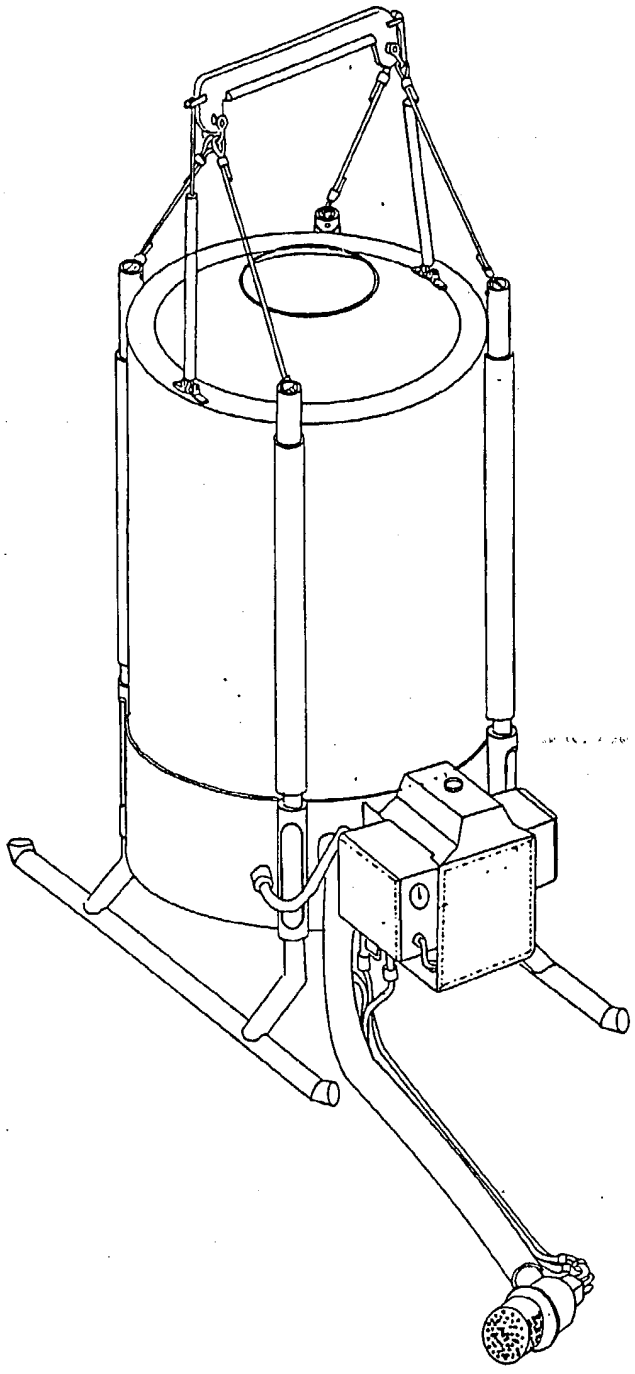
FIGURE 2



INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 94/00107

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: A62C 3/02, B64D 1/16
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: A62C, B64D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 3428276 (A.W. HUBBARD), 18 February 1969 (18.02.69) --	1
X	WO, A2, 9110590 (KOVALETZ, MARK, P.), 25 July 1991 (25.07.91) --	1
X	US, A, 3828857 (MASON), 13 August 1974 (13.08.74) --	1
X	US, A, 3688952 (BARLOW ET AL.), 5 Sept 1972 (05.09.72) --	1

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
27 Sept 1994	27 -09- 1994
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INTERNATIONAL SEARCH REPORT

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

27/08/94

International application No.
PCT/NO 94/00107

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US-A- 3428276	18/02/69	NONE	
WO-A2- 9110590	25/07/91	AU-A- 7341391	05/08/91
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US-A- 3828857	13/08/74	NONE	
US-A- 3688952	05/09/72	NONE	
US-A- 4376466	15/03/83	NONE	
US-A- 4240507	23/12/80	SE-A- 7904199	18/11/79
US-A- 3710868	16/01/73	NONE	
US-A- 4601345	22/07/86	NONE	
US-A- 3661211	09/05/72	NONE	